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APPLIED MATERIALS, INC.  
2881 SCOTT BLVD. M/S 2061  
SANTA CLARA, CA 95050

EXAMINER

PERALTA, GINETTE

ART UNIT PAPER NUMBER

2814

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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Paper No. 35

Application Number: 08/856,116

Filing Date: May 14, 1997

Appellant(s): CHEN ET AL.

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Keith M. Tackett  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed 06/03/2002.

(1) ***Real Party in Interest***

A statement identifying the real party in interest is contained in the brief.

(2) ***Related Appeals and Interferences***

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) ***Status of Claims***

The statement of the status of the claims contained in the brief is correct.

(4) ***Status of Amendments After Final***

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) ***Summary of Invention***

The summary of invention contained in the brief is correct.

(6) ***Issues***

The appellant's statement of the issues in the brief is correct.

(7) ***Grouping of Claims***

The rejection of claims 15-18, 21 and 23 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

(8) ***Claims Appealed***

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) *Prior Art of Record*

5,308,793	TAGUCHI et al.	5-1994
5,674,787	ZHAO et al.	10-1997
4,962,060	SLIWA et al.	10-1990

(10) *Grounds of Rejection*

The following ground(s) of rejection are applicable to the appealed claims:

*Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 15-18, 21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Taguchi et al. (U.S. Pat. 5,308,793) in view of Zhao et al. (U.S. Pat. 5,674,787) and Sliwa et al. (U. S. Pat. 4,962,060).

Regarding claim 15, Taguchi et al. discloses in Figs. 3 to 11 and Col. 6, line 9 to Col. 8, line 24, a method of filling a feature in a dielectric layer that comprises depositing a first barrier layer 21 over a blanket dielectric layer 20 (as shown in Fig. 6); forming a feature through the first barrier layer 21 and the dielectric layer 20 to expose an underlayer (as shown in Fig. 7); depositing a second barrier layer 22 on a bottom and sidewalls in the feature (as shown in Fig. 8); removing the second barrier layer 22

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formed at the bottom of the feature (as shown in Fig. 9); and depositing a metal layer 23, 24 on the underlayer exposed in the feature, wherein the material layer 23 comprises.

Taguchi et al. discloses the claimed invention except for the selective deposition of the metal layer on the underlayer exposed in the feature.

Zhao et al. discloses a method of selectively depositing copper interconnect plugs that comprises forming a feature through a dielectric layer to expose an underlayer; depositing a barrier layer 13 comprising titanium nitride, and selectively depositing copper on the titanium nitride layer for the disclosed intended purpose of selectively depositing copper to form copper plugs in via and contact openings to connect conductive regions on a semiconductor.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize a barrier layer of titanium nitride as both Taguchi et al. and Zhao et al. disclose in order to reduce the electromigration of copper, which is a well known result of the absence of a barrier layer, and to selectively deposit the copper on the titanium nitride layer as Zhao et al. discloses, since Zhao et al. discloses in Col. 2, lines 34-65, that the technique of selectively depositing copper within the via holes to form plugs is attractive, because it eliminates the polishing (CMP) step, it has a low processing cost and a high quality copper is deposited.

Regarding claim 16, Taguchi et al. discloses in Col. 7, lines 32-47 that the first barrier layer and the second barrier layers (21 and 22) comprise  $\text{SiN}_x$ .

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Regarding claim 17, Taguchi et al. discloses in Col. 7, lines 32-47 that the first barrier layer and the second barrier layers (21 and 22) comprise SiN<sub>x</sub> deposited by chemical vapor deposition.

Regarding claim 18, Taguchi et al. discloses in Col. 7, lines 48-52 that the second barrier layer is etched. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use sputter etching as the type of etching used to remove the second barrier layer from the bottom of the feature and the selection of any of the known equivalents to etch would be within the level of ordinary skill in the art.

Regarding claim 21, Taguchi et al. discloses the claimed invention except that aluminum is used as the metal instead of copper. Zhao et al. shows that copper is an equivalent material known in the art. Therefore, because these two metals were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute copper for aluminum. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use copper instead of aluminum, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

Regarding claim 23, Taguchi et al. as modified by Zhao et al. discloses the claimed invention except that the metal layer is deposited by electroless plating instead of electroplating techniques. Sliwa et al. shows in Col. 7, lines 37-51, that electroplating

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and electroless plating are equivalent methods known in the art. Therefore, because these two deposition methods were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute electroplating for electroless deposition.

*(11) Response to Argument*

In regard to Appellant's argument in brief pages 3-5, it is argued that "Taguchi et al., Zhao et al., and Sliwa et al. alone or in combination, do not teach, show or suggest depositing a first barrier layer over a blanket dielectric layer, forming a feature through the first barrier layer and the dielectric layer to expose an underlayer, depositing a second barrier layer on the bottom and sidewalls of the feature, removing the second barrier layer formed at the bottom of the feature, and selectively depositing a metal layer on the underlayer exposed in the feature" and that there is no motivation to combine Taguchi et al.'s conformal titanium barrier layer in order to provide an improved wetting surface for aluminum fill of an opening with Zhao et al.'s deposition of an activation layer 21 of titanium nitride on the exposed bottom of a via prior to the deposition of a plug. However, Taguchi et al. shows that the barrier layer can be one of titanium, titanium nitride, or tungsten silicide among others, and Zhao discloses that the use of copper instead of aluminum in order to reduce manufacturing costs and as copper is well known to replace aluminum in interconnections (Zhao et al., Col. 1, lines 34-66), furthermore, it is well known in the art that when using copper fillings a barrier layer is needed in order to reduce electromigration problems related to copper in

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silicon. Thus, Taguchi et al. recognizes the problem of providing a layer that would improve the deposition of a metal layer and relies in titanium, or titanium nitride among others as a solution, Zhao et al. recognizes the problem of minimizing the polishing steps in order to reduce costs and producing higher quality interconnections and relies on titanium nitride for the selective deposition of copper, Taguchi et al. as modified by Zhao et al. show that a by using the selective deposition of copper on a conformal titanium nitride barrier will produce an interconnection of higher quality and with an improved coverage due to the wetting surface of titanium nitride.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

GP


August 1, 2002

Conferees

Olik Chaudhuri *OC*

Eddie Lee *oc, for*

Ginette Peralta

  
OLIK CHAUDHURI  
SUPERVISOR, PATENT & LITIG  
TECHNOLOGY CENTER 110

PATENT COUNSEL  
APPLIED MATERIALS INC  
P O BOX 450 A  
SANTA CLARA, CA 95052